I claim:

1. An apparatus for generating narrow bandwidth picosecond optical pulses comprising:

a pump laser;

an optical parametric oscillator pumped by a pump pulse train generated by the pump laser;

an optical parametric amplifier having an input coupled to an output of the optical parametric oscillator and pumped by the pump laser,

wherein the optical parametric oscillator comprises an optical cavity comprised of a grating-mirror termination on one end of the cavity and a cavity mirror on an opposing end of the cavity with optically nonlinear active media therebetween.

2. The apparatus of claim 1 where the grating-mirror termination on one end of the cavity is comprised of a grazing incidence grating and a tuning mirror, the grating and mirror being arranged with respect to each other so that a diffracted first order is reflected back from the mirror to the grating and into the cavity.

3. The apparatus of claim 2 where the grazing incidence grating has a periodicity of about equal to the groove spacing of the grating.

4. The apparatus of claim 2 where the cavity has an axis and where the grazing incidence grating is inclined at an approximately 10° angle with respect to the axis.

5. The apparatus of claim 2 where the grazing incidence grating has a blaze optimized for grazing incidence to maximize a first grating order of diffraction.

6. The apparatus of claim 2 where the cavity has an optical length and where the tuning mirror is rotatable about a center defined about the grating so that the resonant wavelength of the cavity can be adjusted without changing the optical length of the cavity.

7. The apparatus of claim 1 where pulses in the optical parametric oscillator are characterized by a bandwidth and where the pump laser introduces a train of pulses into the optical parametric oscillator of sufficient strength to trigger a multiple number of round trips of pulses in the cavity of the optical parametric oscillator in which each reflection of a pulse from the grating-mirror termination narrows the bandwidth of the pulse.

8. The apparatus of claim 1 where the cavity of the optical parametric oscillator further comprises a concave mirror or lens to image light transmitted to and received from the grating-mirror termination to increase stability of the cavity.

9. The apparatus of claim 8 where the light in the cavity is characterized by a wavefront and where the wavefront at the ends of the cavity, including at the grating-mirror termination, is flattened relative to the wavefront at the center of the cavity.

10. The apparatus of claim 1 where the grating-mirror termination couples a 0^{th} order diffraction of light from the cavity of the optical parametric oscillator into the optical parametric amplifier.

11. The apparatus of claim 1 where the pump laser generates a single pulse, which is input into the optical parametric amplifier to coincide with the last pulse of a pulse train output by the optical parametric oscillator and coupled into the input of the optical parametric amplifier.

12. The apparatus of claim 1 where the optically nonlinear active media is comprised of at least one BBO crystal.

13. The apparatus of claim 12 where the optically nonlinear active media is comprised of a pair of BBO crystals arranged with respect to each in a walk-off compensating arrangement to extend power capability of the optical parametric oscillator.

14. The apparatus of claim 13 where each BBO crystal is independently rotatable to adjust an angular orientation of each BBO crystal in the cavity.

15. The apparatus of claim 1 where the optical parametric oscillator and optical parametric amplifier in combination generate a pulse having a bandwidth characterized by a Fourier limit with the bandwidth of the generated pulse being near the Fourier limit.

16. A method for generating a narrow bandwidth picosecond optical pulse comprising:

generating a pump laser pulse train;

pumping an optical parametric oscillator by the pump pulse train;

generating a pulse train output with a narrowed bandwidth and picosecond pulse width from the optical parametric oscillator by use of a grating-mirror termination on one end of a cavity in the optical parametric oscillator and a cavity mirror on an opposing end of the cavity with optically nonlinear active media therebetween;

pumping an optical parametric amplifier having an input coupled to an output of the optical parametric oscillator; and

outputting the narrow bandwidth picosecond optical pulse from the optical parametric amplifier.

17. The method of claim 16 where the grating-mirror termination on one end of the cavity is comprised of a grazing incidence grating and a tuning mirror, and where generating a pulse train output with a narrowed bandwidth and picosecond pulse width

generates a diffracted first order reflected back from the mirror to the grating and into the cavity.

18. The method of claim 17 further comprising providing the grazing incidence grating with a periodicity such that the center wavelength is about a groove spacing.

19. The method of claim 17 where the cavity has an axis and further comprising providing the grazing incidence grating with an inclination of an approximately 10° angle with respect to the axis.

20. The method of claim 17 further comprising providing the grazing incidence grating with a blaze optimized for grazing incidence to maximize a first grating order of diffraction.

21. The method of claim 17 where the cavity has an optical length and further comprising rotating the tuning mirror about a center defined about the grating so that wavelength of the cavity can be adjusted without changing the optical length of the cavity.

22. The method of claim 16 where pumping an optical parametric oscillator comprises pumping the optical parametric oscillator with pulses characterized by a bandwidth and sufficient strength to trigger a multiple number of round trips of pulses in

the cavity of the optical parametric oscillator in which each reflection of a pulse from the grating-mirror termination narrows the bandwidth of the pulse.

23. The method of claim 16 further comprising stabilizing the cavity of the optical parametric oscillator by providing a concave mirror or lens in the cavity to image light transmitted to and received from the grating-mirror termination to increase stability of the cavity.

24. The method of claim 23 where the light in the cavity is characterized by a wavefront and where stabilizing the cavity of the optical parametric oscillator comprises flattening the wavefront of the light at the grating-mirror termination relative to the wavefront at the center of the cavity.

25. The method of claim 16 where generating a pulse train output with a narrowed bandwidth and picosecond pulse width couples a 0^{th} order diffraction of light from the cavity of the optical parametric oscillator into the optical parametric amplifier.

26. The method of claim 16 where outputting the narrow bandwidth picosecond optical pulse inputs a single pulse from the pump laser pulse train into the optical parametric amplifier to coincide with the last pulse of a pulse train output by the optical parametric oscillator and coupled into the input of the optical parametric amplifier.

27. The method of claim 16 where generating a pulse train output from the optical parametric oscillator comprises generating the pulse train in at least one BBO crystal.

28. The method of claim 27 where generating a pulse train output from the optical parametric oscillator comprises generating the pulse train in a pair of BBO crystals arranged with respect to each in a walk-off compensating arrangement to extend power capability of the optical parametric oscillator.

29. The method of claim 28 further comprising independently rotating each BBO crystal to adjust an angular orientation of each BBO crystal in the cavity.

30. The method of claim 16 where outputting the narrow bandwidth picosecond optical pulse from the optical parametric amplifier comprises generating a pulse having a bandwidth characterized by a Fourier limit with the bandwidth of the generated pulse being near the Fourier limit.